Hydrologic Extremes

David R. Easterling
Center for Weather and Climate
NOAA/National Centers for Environmental Information
(formerly National Climatic Data Center)
Asheville, NC

Task Force on the Feasibility of a Climate Extremes USGCRP Assessment

Task Force Members

- Stephanie Herring, Chair
- Jeff Arnold
- Tom Delworth
- David Easterling
- Marty Hoerling
- Ian Kraucunas
- Ken Kunkel
- Richard Moss

Request to Task Force

- Evaluate the purpose and scope of a special assessment on observed and projected 21st century changes to climate extremes.
- Consider:
  - Scientific progress
  - Information needs
  - Coverage of past assessments
  - Opportunity to deliver information to assist climate risk management and explore issues in sustained assessment

Identifying Information Needs

- There is a great deal of existing information about user needs already available to USGCRP.
  - Federal agency adaptation plans
  - NCA3 Workshop Reports and Sectoral/Regional Chapters
  - …
- Evaluate existing information first, then engage in a focused way to fill gaps in understanding of needs.

The Challenge: Differences in Information Needs and Science for Each Extreme Type

- Differences in state of science for each type, including:
  - Observational capabilities
  - Changes in trends, and confidence in predictions and projections
  - Relationship to anthropogenic climate change
- Too many sets of users with specific questions and needs to be addressed in a single report
  - Varied impacts and vulnerabilities
  - Need for “translation” through impacts models and other products such as hydrographs
  - Different capacities to integrate scientific information

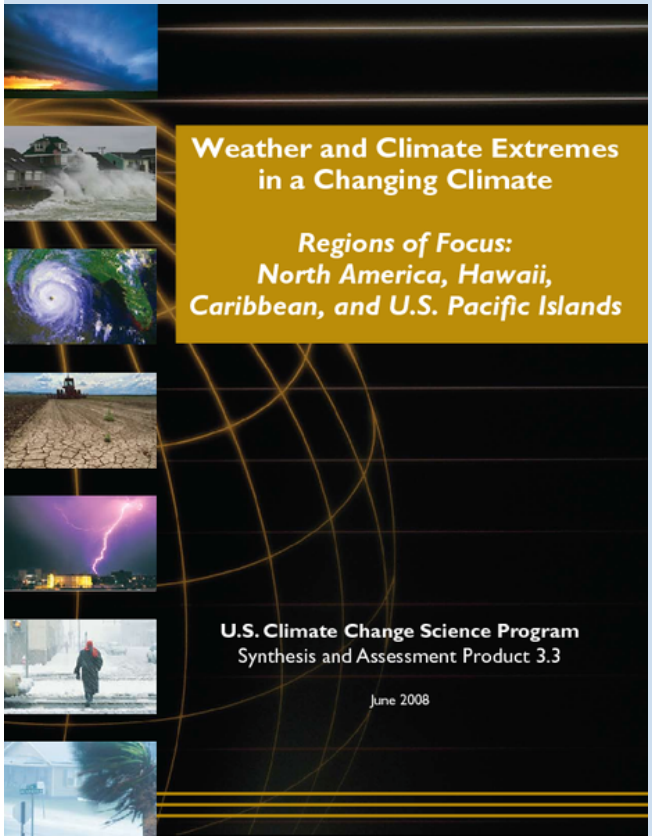
Task Force's Solution

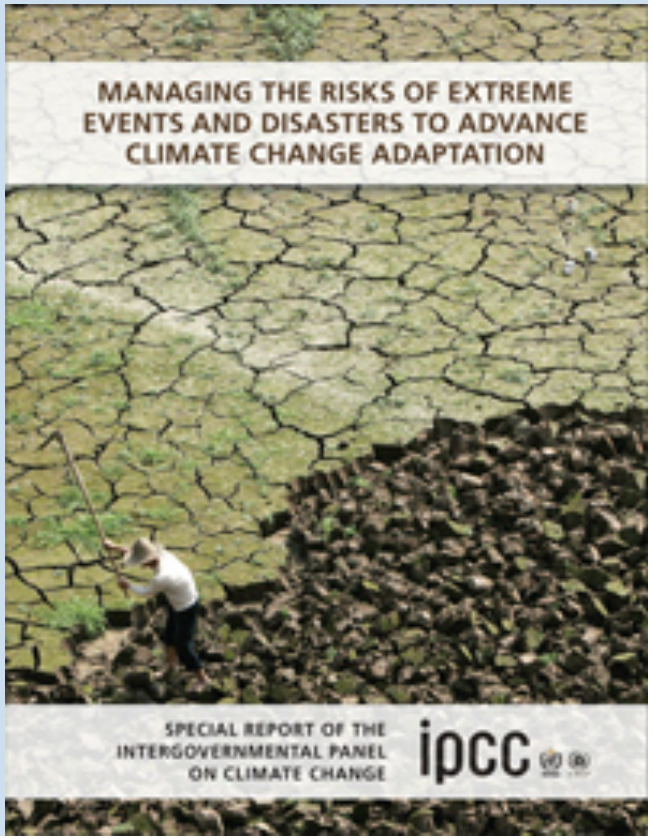
- Do not prepare another comprehensive assessment report on extremes.
- Conduct a series of shorter, targeted assessments, each focused on a specific extreme event type and users, that would be initiated by interested agencies.
  - Each assessment would provide information on the state of science keyed to specific risk management information needs.
  - Multiple agencies and expert communities would participate in preparing and reviewing each assessment.
  - The series would also explore new products, communication methods, and ways to sustain interactions with user groups.

Resources

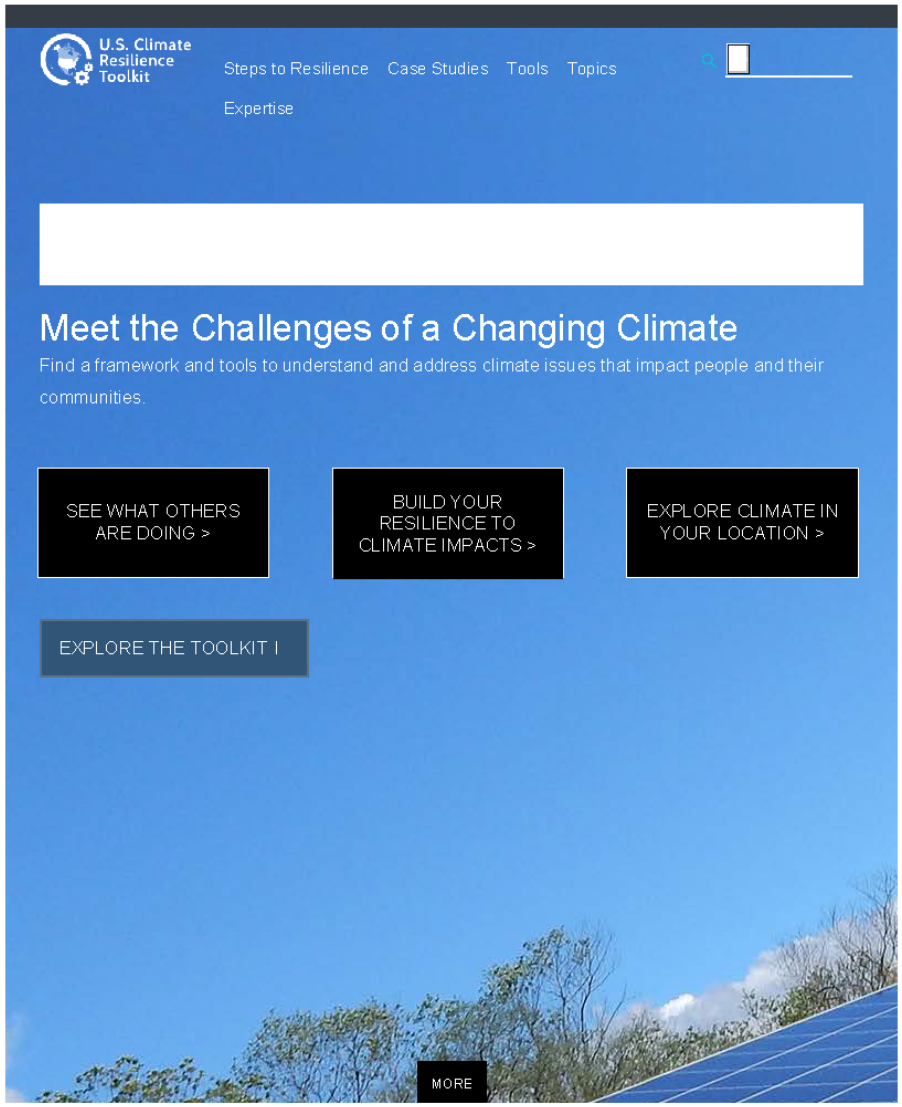
Assessments

- Climate Change Science Program 3.3 (2008)
- IPCC Special Report on Extremes (2012)





U.S. Climate Resilience Toolkit | U.S. Climate Resilience Toolkit



https://toolkit.climate.gov/[9/12/2016 2:41:39 PM]

toolkit.climate.gov

Climate Resilience ToolKit

U.S. Climate Resilience Toolkit | U.S. Climate Resilience Toolkit

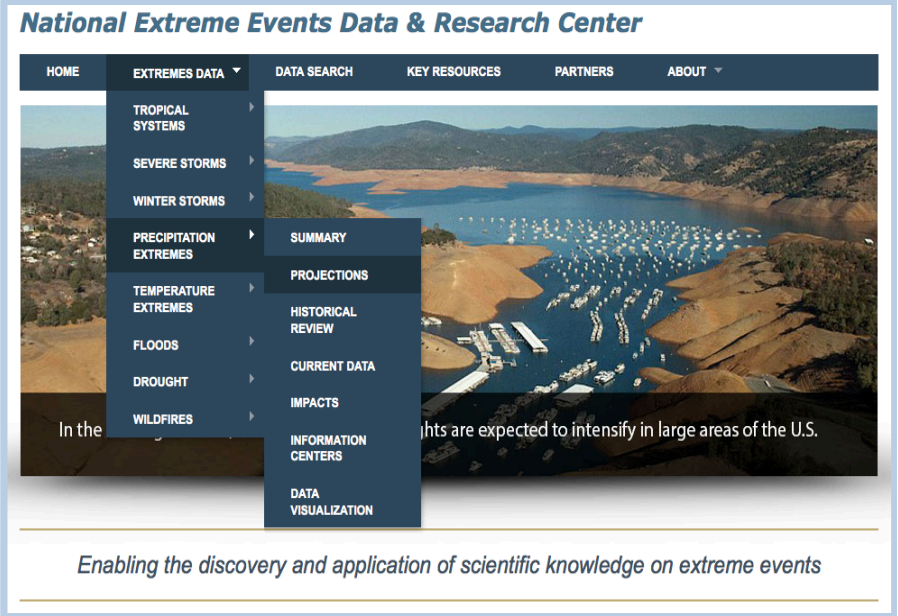
https://toolkit.climate.gov/[9/12/2016 2:41:39 PM]

The Oak Ridge National Labs: National Extreme Events Data and Research Center (NEED)

Partnership: CCSI, EESR, NCSU, TWC, et al.

- **Goals:**

1. Provide easy access to authoritative information and data on historical and projected extreme climate and weather events
2. Improved understanding and forecasting of extreme events through basic and applied research that leverages the NEED knowledge base and ORNL's computing, modeling, and data capabilities



- **Components:**

1. Extremes Portal

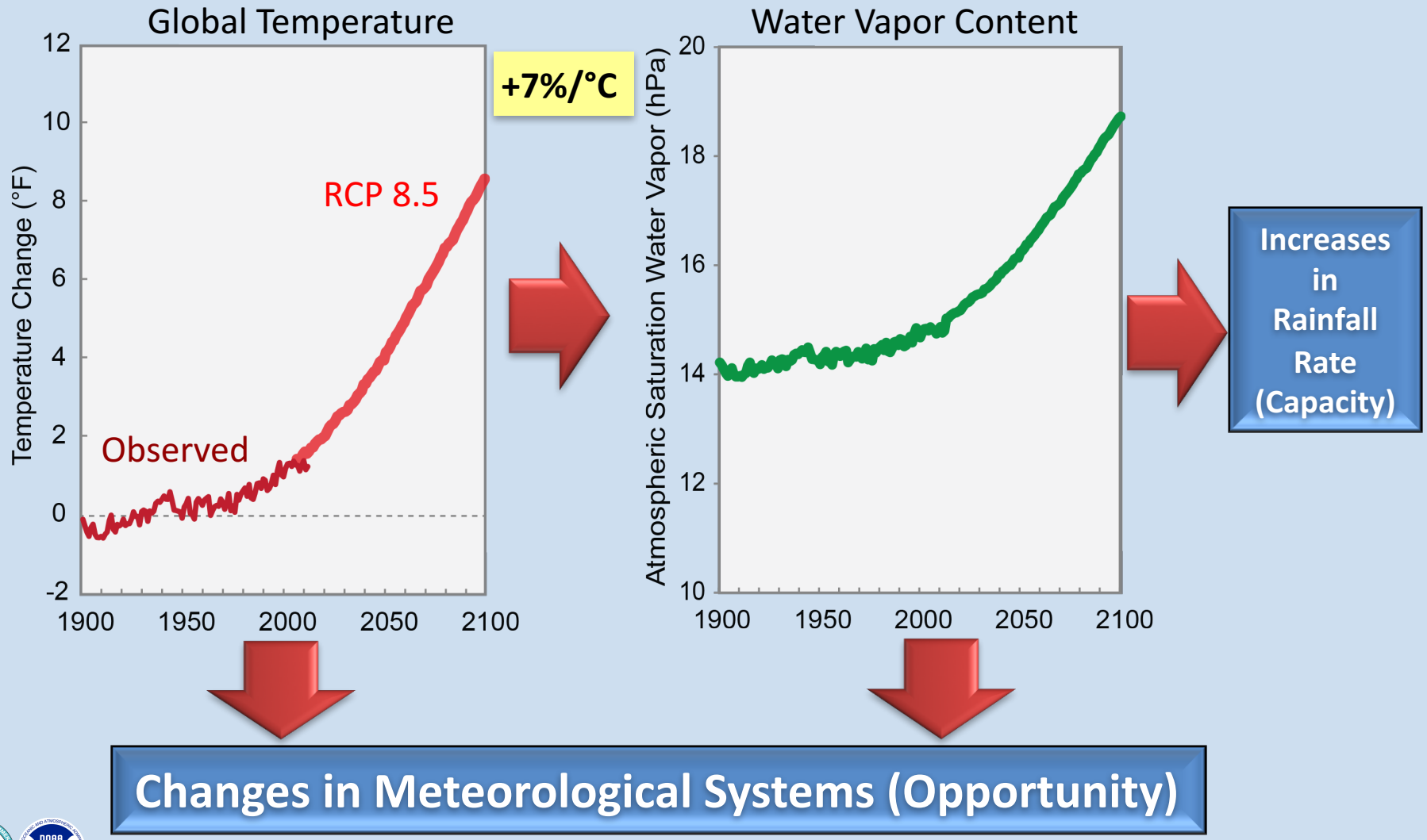
- Knowledge base: historical extremes data and model projections of extremes (heat/cold waves, floods/droughts, etc.); syntheses of knowledge based on event-specific impact, cost, and recovery data; and extremes research publications
- Website: discover data/information by event type or search knowledge base using category/keyword interface

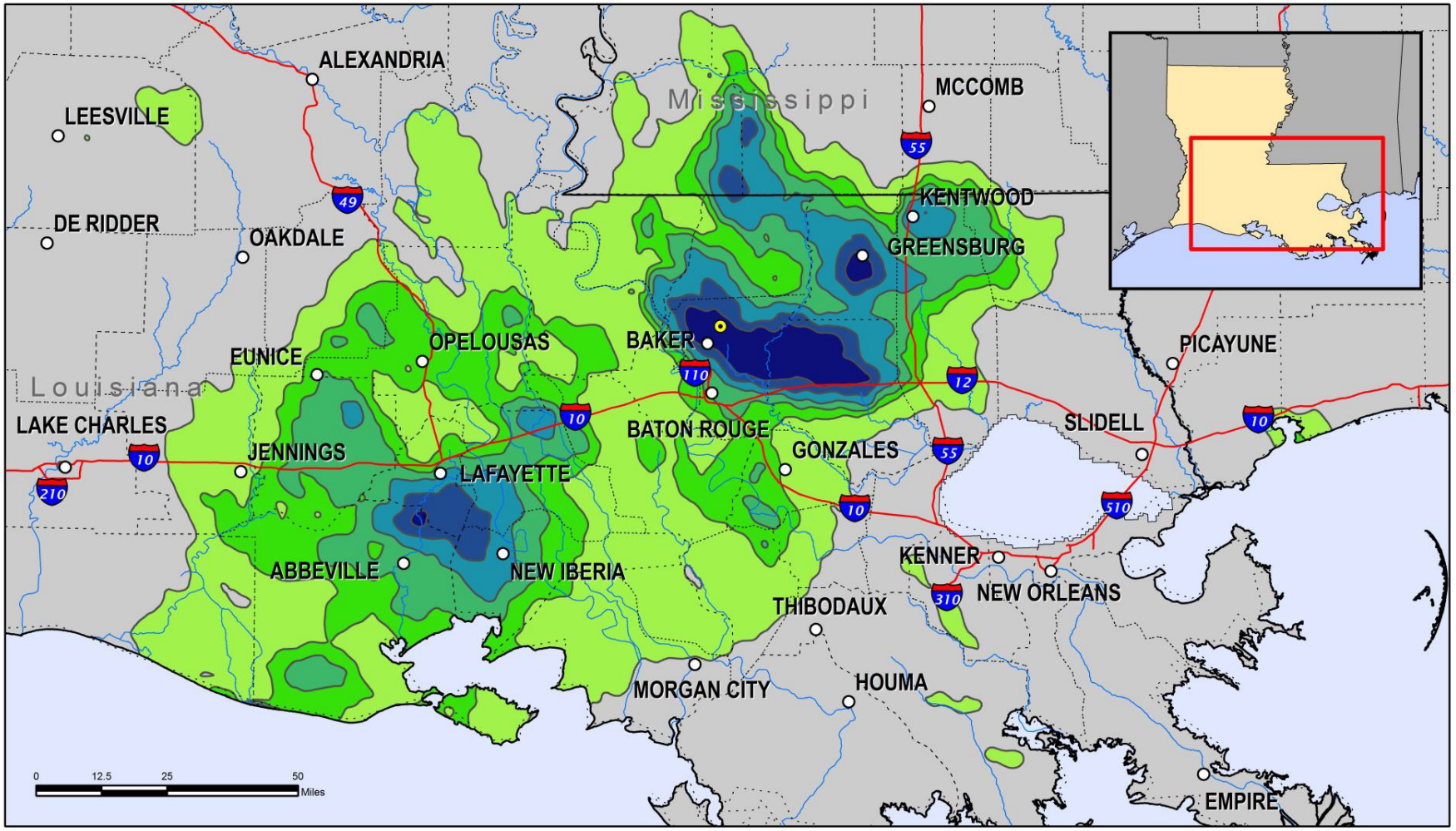
2. Analysis and Modeling Framework: Study links between extreme upper-air ridges and surface heat events

- Use feature-detection algorithms to identify, track, and measure duration of related 500 mb and T_s extremes in reanalysis products
- Machine-learning methods better define the spatiotemporal relationships between upper-air and surface extremes
- New extremes metrics derived and tested in CESM simulations

Technical Background

Global Warming->Saturation Water Vapor Increases





Louisiana, 11 - 13 August 2016
Annual Exceedance Probabilities (AEPs) for the Worst Case 48-hour Rainfall

Hydrometeorological Design Studies Center
Office of Water Prediction, National Weather Service
National Oceanic and Atmospheric Administration

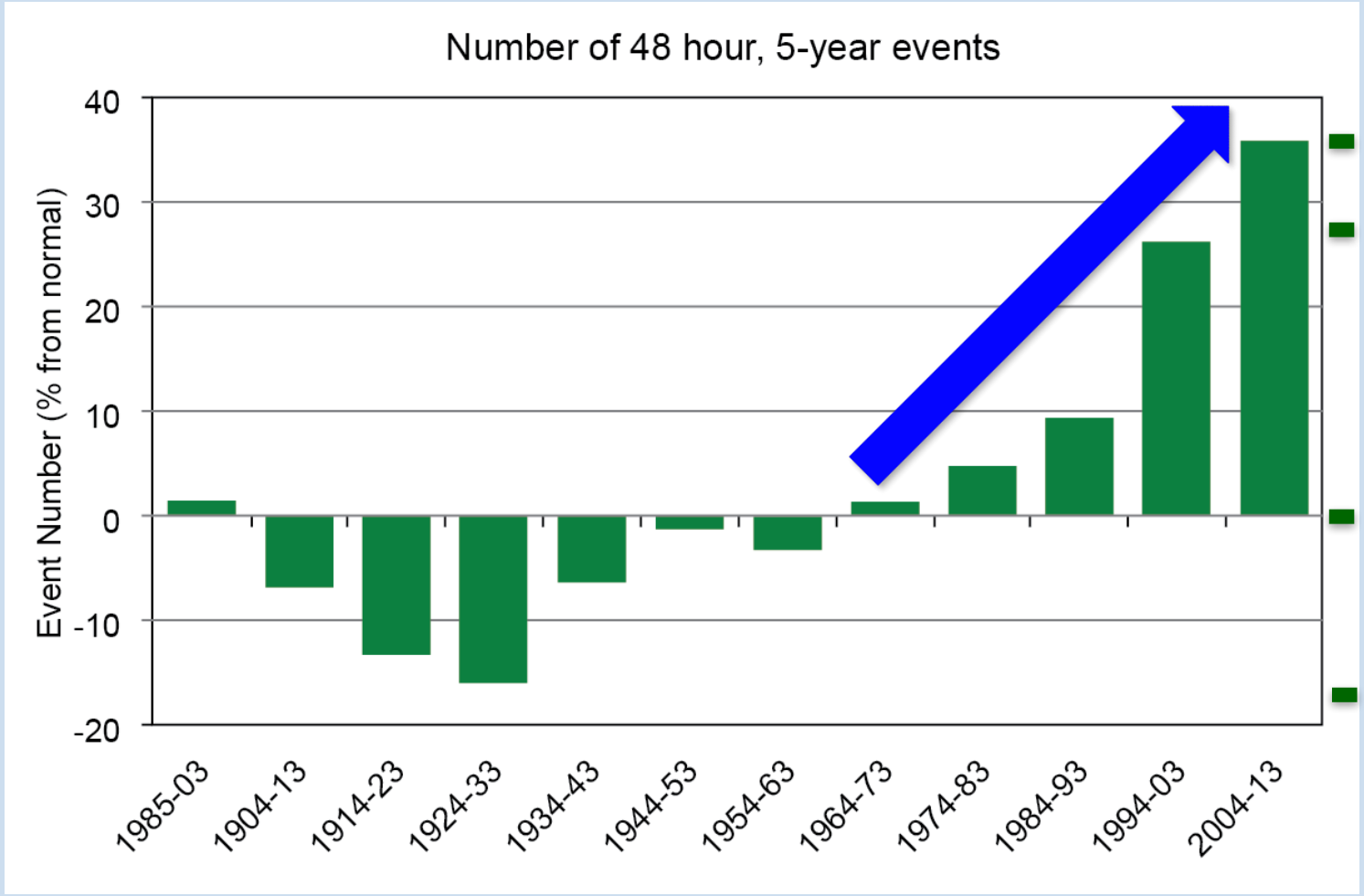
http://www.nws.noaa.gov/ohd/hdsc/

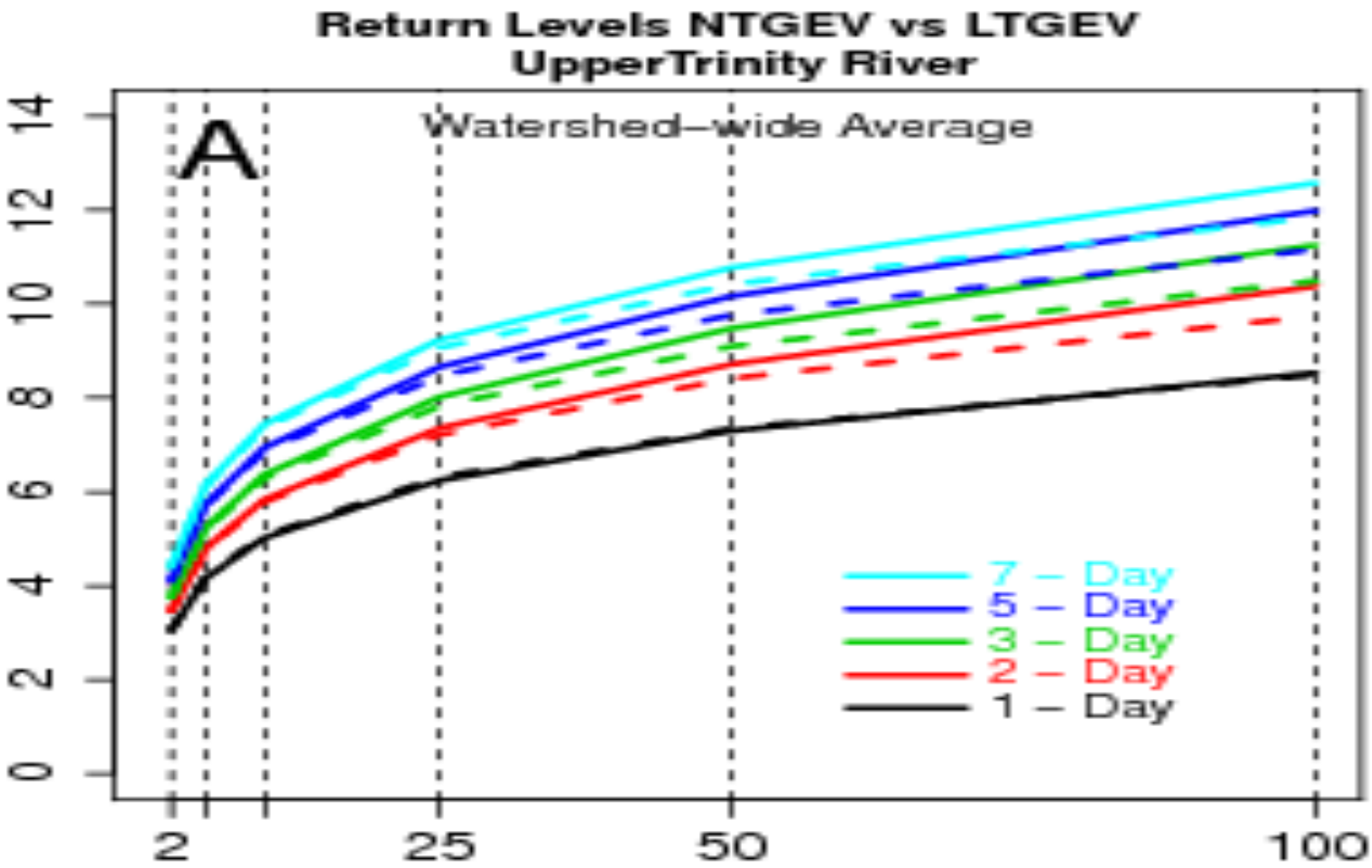
Created 16 August 2016
Rainfall frequency estimates are from NOAA Atlas 14, Volume 9, Version 2.
Rainfall values come from 6-hour Stage IV data.

N

- > 1/10
- 1/50 - 1/10
- 1/100 - 1/50
- 1/200 - 1/100
- 1/500 - 1/200
- 1/1000 - 1/500
- < 1/1000

Upward U.S. Trends in Extreme Precipitation





NOAA Atlas 14 provides return period values for specific locations.

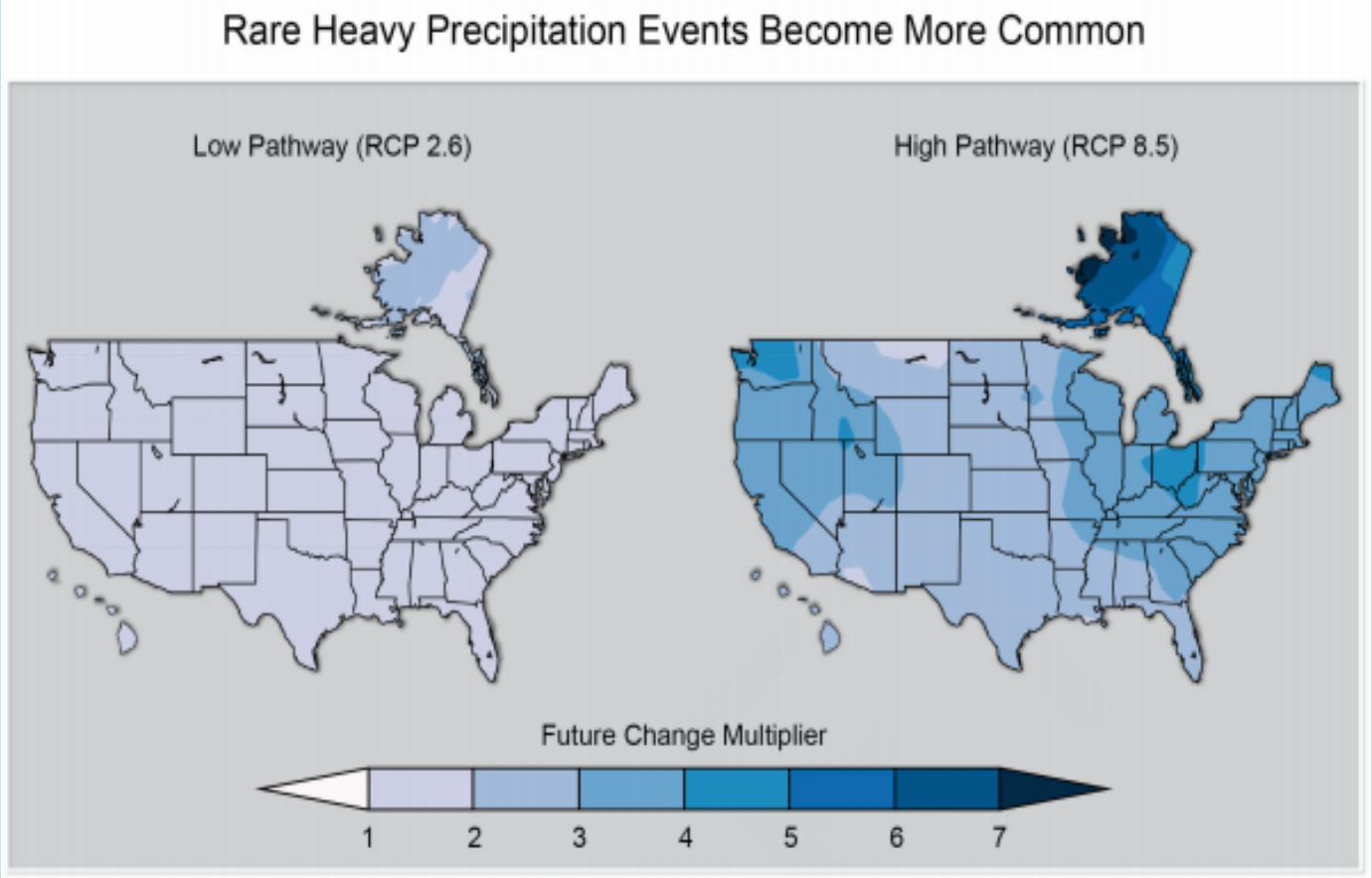
Old: considered climate stationary.

New: now beginning to consider trends.

Precipitation Depth w.r.t. 5 Durations. Solid is trend GEV model, dashed is stationary GEV model.

Rare Heavy Precipitation Events Become More Common

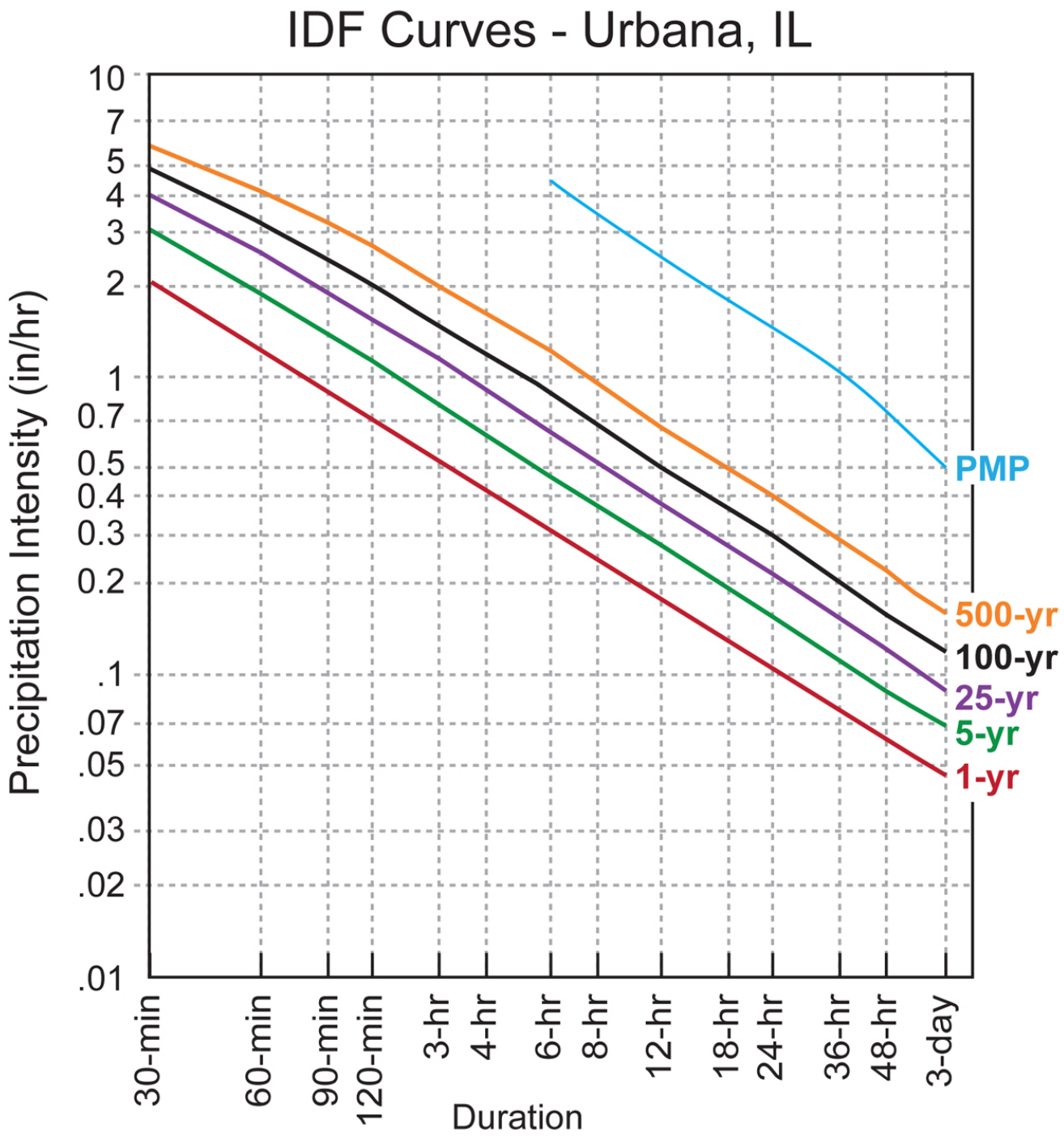
- Once-in-20-year events
- 2081-2100 compared to 1981-2000
- Low emissions scenario (left)
  - Up to about twice as often
- High emissions scenario (right)
  - Up to five times as often



Melillo et al. 2013 National Climate Assessment Draft for Public Comment

Probable Maximum Precipitation

- Theoretical maximum amount of precipitation possible for a given duration assuming perfect conditions for maximizing rainfall.
- Used in dam spillway certification, and other uses.
- Some States are having them recalculated and in most instances recalculated values are much lower than original values. In some locations the new PMP is approaching what has been observed.

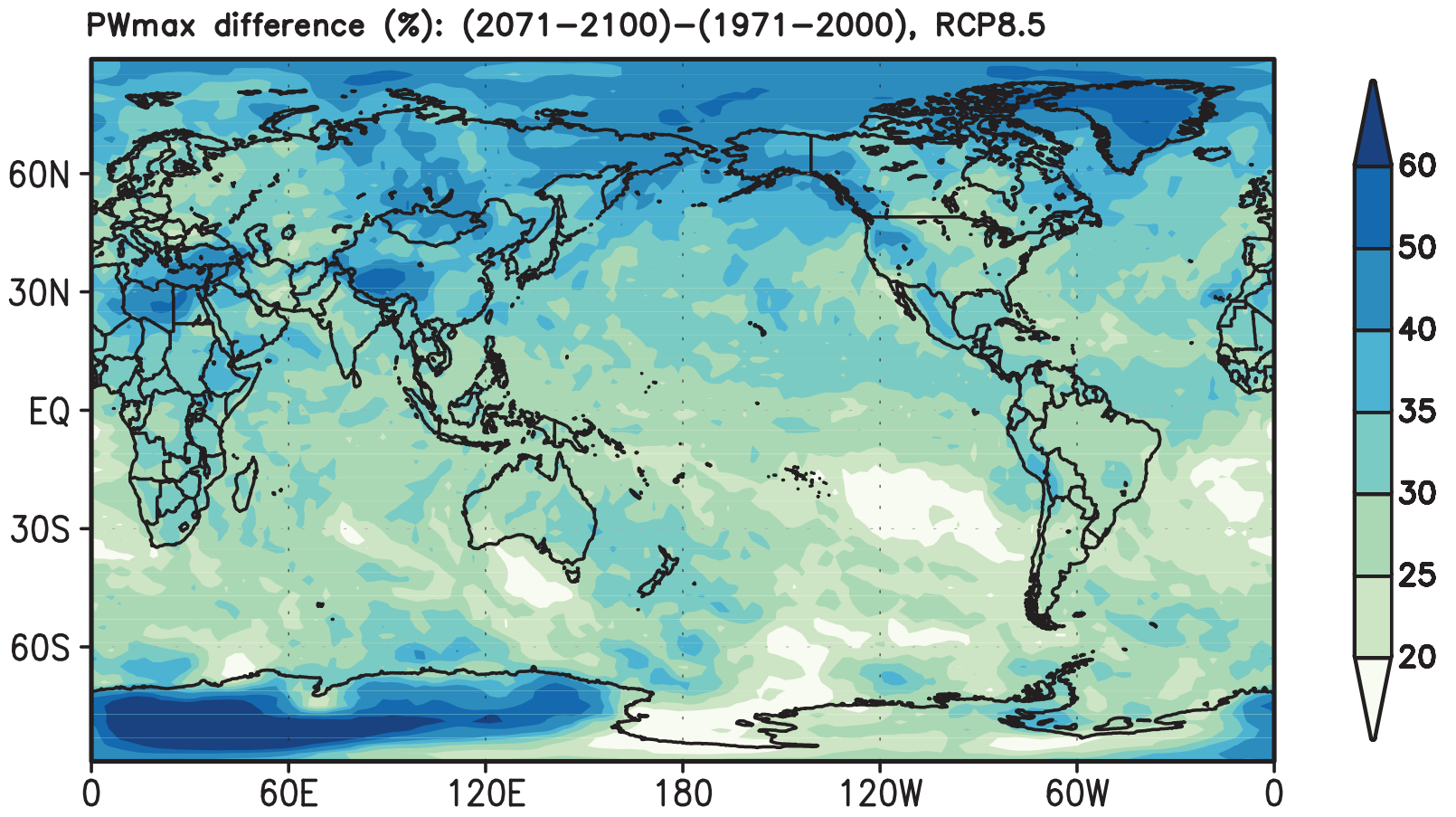


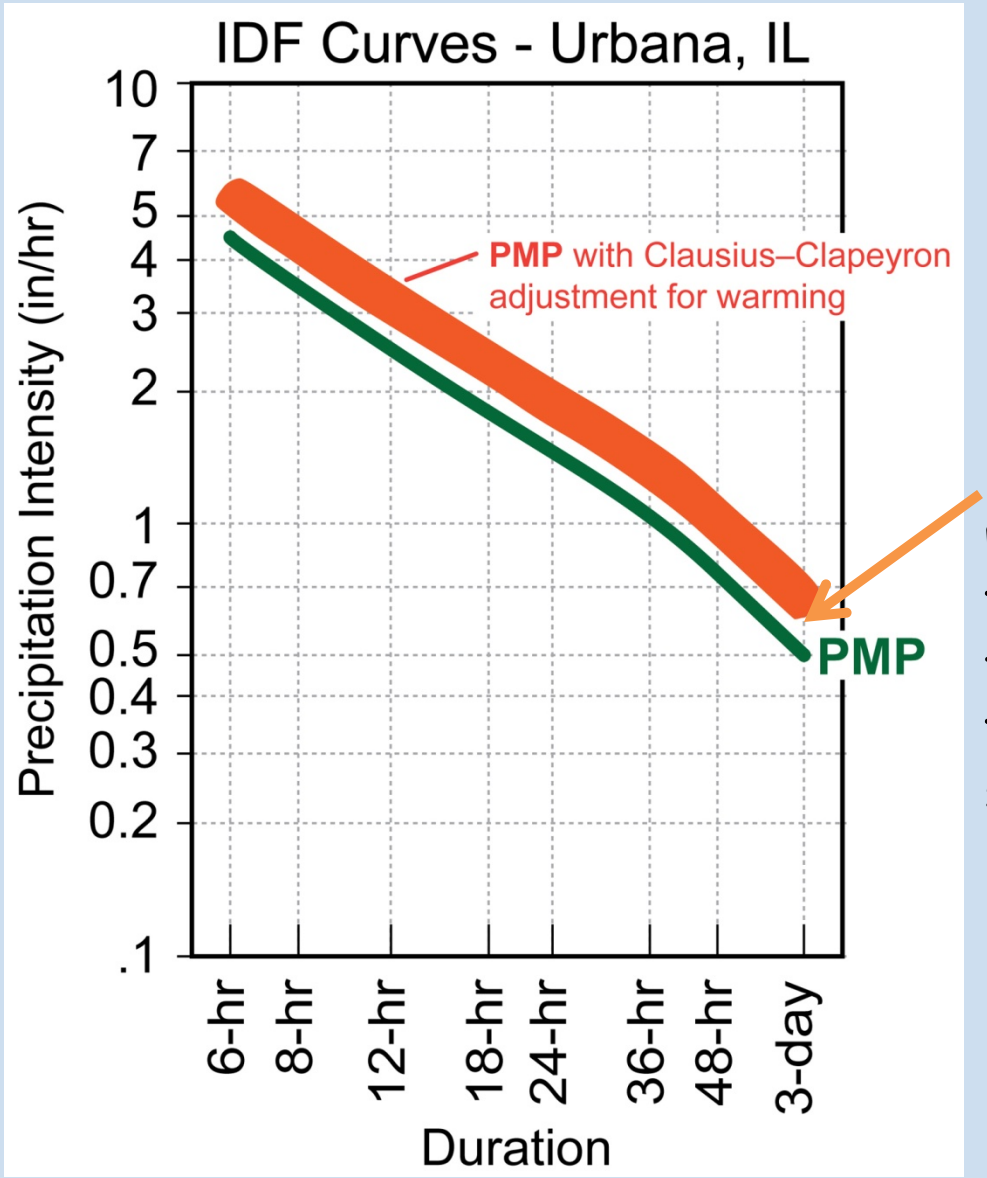
24h totals

Probable Max. Precip. (PMP): 36 in (914mm)

500-yr: 9.6 in (244mm)
100-yr: 7.2 in (183mm)
25-yr: 5.4 in (137mm)
5-yr: 4.0 in (102mm)
1yr: 2.7 in (69mm)

Model-Simulated Future Changes in Maximum Atmospheric Water Content





3-day precipitation total changes from 36 inches to a range of 40-54 inches

Questions?